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Contribution of Welding Pratices to Ocular Injuries in Owerri Municipal Imo State Nigeria

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ABSTRACT

The eye remains the delicate organ in the body. A number of things can go wrong in any of the structures of the eye, causing visual impairment and blindness when fully not protected during welding practices. This study gave contributions to the welding practices that were associated with ocular injuries in Owerri Municipal, Imo state Nigeria. A total of 200 sample of the welders was identified from a list of registered workshops and Structured, pretested questionnaires elicited in English language was used to collect data from 200 consenting welders. A cross sectional study was used for the study. Using uncontrolled direct observation and face to face interview method as the sampling technique. Method of data anaiysis was Descriptive. Eye screening and examination were used to validate questionnaire findings. It was found that age, marital status and work category showed a moderate association with the awareness of prevalence of eye diseases but with strong association with ocular eye injuries as the correlation coefficients is 0.898, 0.893, 0.930 and 0.865 respectively. Combined 200 welding related ocular eye injury claims, 93 welders had ocular eye injury giving a prevalence of (84.5%). Single eye injuries were distributed evenly among the left and right eye (42.0%). The most frequent nature of injury was foreign body (51.5%) and then burns (20.2%). It is concluded that exposure to the radiations emitted during welding at the welder's work environment without appropriate protection gear mainly produce the ocular conditions, including pterygium, photokeratitis and cataract with their major symptoms, such as burning sensations, photophobia and eye pain. Consistent use of eye protection, face protection should be encourage. Enlightenment program should be embarked on. These findings therefore have provided possible guidelines for proper education, awareness and screening of welders to avoid eye injuries.

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INTRODUCTION

The eyes of the worker in every occupation are his most valuable asset (Ashby, 2012). Despite the fact that the eyes represent only 0.29% of the total body surface area 4% of the facial area, they are the third most common organ affected by injuries after the hands and feets (Azian, 2012). Eye injury as a facet of everyday life is presumably fast becoming a common causes of presentation and admission at health centres in Nigeria. Studies have shown that approximately one half of parents who present to an eye causality department are cases of ocular trauma (Bellows and Bellows, 2015). About 15% of the most common types of injuries are welding related and 21% of all eye injury claims are made by welders. The arduous nature of these jobs makes the worker vulnerable to accidents as the workers are exposed to such hazards as flying metal chips, burns in the eye and injury from radiation (Gofff, 2006).

Welding is the process of joining two metal parts together by applying intense heat between them, which causes the parts to intermix after melting. Welding processes are widely used for the manufacture of shipyards, civil engineering structures, mining, industry transportation means, petrochemical industry and metallurgy (Azian,2012). All welding processes generate fumes but most fumes are produced during electric are welding. The thermal effects can cause agglomeration of the particles into particle human chains and dusters that can be

deposited in the human respiratory tract or even enter the eye (Ashby, 2002, Flore, 2006 & Ravert, 2006). In electric are welding, electric are is struck between the metallic electrodes and work piece tiny globules of molten metal are transferred from the metal electrode to the weld joint. A welder or clamping device with an insulated handle is used to conduct the welding current to the electrode. A return circuit to the power source is made by means of clamp to the work piece (Nicholas etal., 2010).

Welding smoke is a mixture of very fine particles (fumes) and gases. Welding fumes and gases comes from base materials been welded or filter material that is used, coating and paints on the metal being welded or coat covering the electrode, shielding gases supplied from cylinder, chemical reaction resulting from the action of ultraviolet light from the are or heat, process and consumables used and contaminants in the air. Route of exposure to welding smoke is mainly through inhalation or eye contact. The amount and type of metals and gases found in welding smoke will depend on the welding process and base metal used (Zimmer etal., 2001). Type of metals commonly found in the welding fumes include Aluminum, Beryllium, Candium oxides, Chromium, Cooper, Fluorides, iron-oxide, Lead, Manganese, Molybdenum, Nikel Vanadium, Zinc-oxide (Coggen, etal., 1994, 1995). Welding practices produce gases which contain carbon-monoxide, fluorine, Hydrogen-fluoride, and Nitrogen-oxide. There are several types of welding which includes forge, arc, gas, alumimethermic, ultrasonic and electron beam welding.

However, there are two major types namely, Shielded Metal Arc (SMA) and gas (oxyacetylene) welding (Howden, *et* 2009). (SMA) is the most common type of welding used in industry (Pang 2307). Welding emits high levels of UVR, metal fumes and gases and exposure to these adverse effects could potentially cause injury to workers (Pang *et at.,* 2007 and Sithole *et al*., (2009) The spectral emission of welding arcs peaks in the ultraviolet and blue light region of the spectrum and for this reason, the amount of energy in this region is potentially more hazardous to the eyes (Sliney, 2006); therefore welders protect must themselves against these radiations.

A study of the pattern of eye diseases is very important because while some eye conditions are just causes of ocular morbidity others invariably lead to blindness. Thus, there are other ocular and systemic problems associated with welding, and these include foreign objects entering the eye, fume entering the eyes, electric shock and injuries resulting from explosion (Howden *et al.,* 1998). Hazardous gases such as carbon dioxide, carbon monoxide, nitrogen oxide and ozone are associated with the welding process and when welding takes place in a poorly ventilated or confined space, these gases are more likely to cause eye irritation also. Sithole *et al.,* 2009). The diseases and hazards associated with the welding process depend on the type of welding, the materials (base metals, surface coatings, electrodes) to be welded, and the environmental conditions. (Sithole *et al.,* 2009). Welders generally shield themselves from harmful radiation and mechanical injuries by using protective devices such as safety goggles, helmets and face shields (Goff, 2006 and Sithole *et al.,* 2009).

Materials

Study Area

This study was carried out in Owerri Municipal Council Area of Imo State, South Eastern Nigeria. The area constitutes approximately a major city of Imo State, Nigeria. It has an area of 58 km^2 and a population of 983,000 according to the 2023 Nigeria Population Commission. The postal code of the area is 460. Owerri city sits at the intersection of roads from Port Harcourt, Onitsha, Aba, Orlu, Okigwe and Umuahia.

Population of the Study: The Study population is all in Owerri Municipal were used for the study, with their (ages ranging from 15 to 50 years; 80% males and 20% female. se welders came from different socio-cultural, socio-economic, and educational backgrounds. The sample population comprised 90 Electric welders (76.9%) and 27 Gas (23.1%) welders. The study sample comprised of two hundred consenting welders selected from different locations at Owerri Municipal. Using uncontrolled direct observation and face to face interview method, the researcher went ahead as data was collected. The welders were directly met at their workplaces and asked the relevant questions (case history).

Instruments for Data Collection

The following instruments were used in the research study:

1. Illiterate and literate visual acuity charts (both far and near)
2. Occluder
3. Pen torch
4. Ophthalmoscope
5. Slit lamp biomicroscope

The case history of the selected welders was taken utilizing objective and subjective methods of data collection. Visual acuities of the welders were taken with the snellen chart at distance 6m and near 40cm,

consisting of both literate and iterate charts; this test was done monocularly and binocularly and recorded. The pen torch was used for external examination for foreign bodies and presence of light perception and then the ophthalmoscope for internal examination. Finally, the slit lamp microscope was used for further examination of the anterior c posterior segments of their methods

Research Design

A cross-sectional study was used for the study. The cross-sectional design therefore was considered most appropriate for the present study as it has effectively been utilized in related studies.

Method of administration of instrument and data collection

The welders were met at their work place, where the essence and Procedure of the study were explained to them. This boosted their interest and participation, especially as their identities would be revealed. However, while some complied others did not; each was afraid to be examined first.

Data collection processes lasted for 3 months. Data was collected by administering structured pretested questionnaires to the study participants by members of the study group. For the selected participants, the study was once more introduced and informed consent was sought for their participation in the study. For those Who gave their consent, the questionnaire was then elicited in the local (Igbo) language. Also, all patients underwent a comprehensive ocular examination including visual acuity (using Snellen chart), examination of the anterior segment using penlight and funduscopy using direct ophthalmoscope. Data collected were analysed using descriptive statistical methods, frequency distribution tables were generated for all data collected.

Method of data Analysis

The method of data analysis was descriptive, data collected were presented in tables of sequence distribution and were all expressed as the percentage of the distribution. Findings were illustrated as tables, bar charts and pie charts where appropriate. Chi square was used to test for associations between social demographic characteristics of welders and prevalence of different types of eye disease at 5% significant level. Data analysis was performed on IBM-SPSS Statistics version 20.

RESULTS

Socio-demographic characteristics

Eye injuries accounted for 10.0% of all workers' compensation claims. Welders comprised 200 cases or 5.1% of all eye injury claims. Eye injuries accounted for 25% of all claims filed by welders; 80% we male, while 20% were female. 36-40 (23.0%) have the highest age, followed by 31-35 (20.0%) age. Primary work category was available for 50.0% of workers; manufacturing (12.0%), services (10.0%), and construction (20.0%). The most frequent two digit subgroups under manufacturing were industrial, commercial machinery, computer equipment, and fabricated metal products.

Socio-demographic characteristics

Characteristics	Frequency	Percentage
Sex		
Male	170	80.0
Female	30	20.0
Total	200	100
Age (Years)		
15-20	5	3.0
21-25	20	5.0
26-30	35	15.5
31-35	40	20.0
36-40	45	23.0
41-45	25	21.5
46-50	30	10.0
Total	200	100
Work Category	15	12.0
Manufacturing	40	20.0
Construction	25	10.0
Services	10	4.0
Wholesale	10	4.0
Transportation	100	50.0
Gas, Services and Finance	200	100
Total	200	100.0

Administration	0	0
Agriculture, forestry, fishing and mining	200	100
Non		
Total		

Occupational profile of welders in Owerri Municipal

From table 4.2, 20.7% started welding at the age of 15 years, 41.3% started welding that the age of 15-18 years, while 92% started welding at the of 18 years. 92% of the welders are interested in welding while 0.7% was forced to weld. 92% inherited welding as a family business, while 4.7% have no alternative options. 149% are not certified training in welding, while 0.7% are certified in welding. About 96% learn stainless steel, 100% learn by observing co-workers/seniors, 92.7% learn metal arc welding.

Occupational profile of welders in Owerri Municipal

Baseline characteristic	Groups	Welders (*n* = 150)
Age started welding	<15 years	31 (20.7%)
	15–18 years	62 (41.3%)
	>18 years	57 (38%)
Reason for welding	Interest in welding	138 (92%)
	Forced to weld	1 (0.7%)
	Inherited as a family business	4 (2.7%)
	No alternative options	7 (4.7%)
Welding experience	<10 years	51 (34%)
	10–20 years	49 (32.7%)
	>20 years	50 (33.3%)
Certified training in welding	Yes	1 (0.7%)
	No	149 (99.3%)
How did you learn welding?	Observing co-workers/seniors	150 (100%)
Welding type	Metal arc welding	139 (92.7%)
	Gas metal arc welding	11 (7.4%)
Metal type	Stainless steel	144 (96%)
	Aluminum/Brass	6 (4%)

Ocular eye injury characteristics

Of the combined 200 welding related ocular eye injury claims, 7.0% were bilateral; 84.5% welders had bilateral injuries. Single eye injuries were distributed evenly among the left and right eye 42.0%. The most frequent nature of injury was foreign body (51.5%) and then burns (20.2%).

Among welders, foreign bodies (51.5%) and burns (20.2%) were most common, followed by inflammation, laceration, and contusions (each comprised less than 3% of the total). In comparing the nature of injury for welders to all other worker eye injury claims reported for the year, welders had proportionally more burns than workers in other occupations reporting eye injuries demonstrating greater exposure. Location of injured eye could not be determined for 11 workers. Includes infection or contagious, poisoning/chemical, strain, puncture, radiation, vision loss, and unspecified. Percentages may not sum to 100% due to rounding.

Ocular Eye injury characteristics for welders

Characteristics	Frequency	Percentage
Ocular Eye Injury		
Single	84	42.0
Right	46	28.0
Left	30	22.0
Unspecified	25	15.5
Bilateral	93	84.5%
Nature of Injury		
Foreign body	50	51.5
Burn	40	20.2
Inflammation	26	10.1
Laceration	20	5.2
Contusion	15	3.1
Others	22	12.2

Distribution of ocular injuries according to type of welding process

A total of two hundred (200) ocular injuries were recorded among the 93 subjects who had ocular injury. Superficial foreign body 51(43.6%) was the most common type of ocular injury. Flying object (47.3%) was reported by the welders with ocular injury to be the major cause of ocular injury followed by ultraviolet rays (45.2%) while gas splash accounted for 7.5%. 76.9% of all the injuries recorded occurred among electric welders

Distribution of ocular injuries according to type of welding process

Type of welding process	Superficial Foreign body	Corneal Abrasion	Photo keratitis	Conjunctival scarring	Total	(%)
Electric welding	45	9	30	6	90	76.9
Gas welding	6	3	18	-	27	23.1
Total	51	12	48	6	200	100
Percentage (%)	43.6	10.3	41.0	5.1	100	

Use of protective eye wear among all the welders

Ocular injuries (39.3%) were recorded among welders who had spent longer number of years on the job (11 years and above) than those who had only spent 1-2 years (4.3% of ocular injuries) on the job. Only 33(35.5%) of the 93 injured welders were using protective eyewear at the time of the injury.

Use of protective eye wear among all the welders

Use of protective eye wear while working	Ocular Injury		Total
	Present	Absent	
Yes	33	10	43 (39.1%)
Nil	60	7	67 (60.9%)
Total	93 (84.5%)	17 (15.5%)	110

Table 4.6 shows the influence of the type of welding technique on the ocular findings, after excluding those who utilize both types of welding techniques. Although no significant difference was found between those who have pinguecula and Pterygium, however, there is greater odd in developing these disorders in arc welders than in gas welders. (OR=1.015, 1.039.) The confidence interval including 1 means that there is no difference between arc and gas welders developing pinguecula and pterygium.

Relationship between ocular findings and type of welding

Ocular finding	Arc welding	Gas welding	Chi square	P-value	Odds ratio		Confidence interval
Pinguecula	143	46	0.014	0.452	1.015	0.902-	1.142
Pterygium	55	16	0.124	0.368	1.039	0.901-	1.197
Cornea opacity	34	3	5.266	0.007	1.256	1.118-	1.410
Pigmentary ma ocular changes	31	0	5.664	0.003	1.357	1.274-	1.445
Maculardrusen	16(5.8)	0	4.232	<0.001	1.351	1.270-	1.438

Discussion

In this study, of the combined 200 welding related ocular eye injury claims, 93 welders had ocular eye injury giving a prevalence of 84.5%. A similar study in eastern part of Nigeria showed the prevalence of ocular injuries to be 28.5%19. Our prevalence thus appears to be higher than that reported in this other study and could be attributed to increasing industrialization in our study area. Owerri metropolis presently is the largest commercial town in Imo State, Nigeria and boasts of high level engagement in welding work by individuals in the town. Majority of the welders were between 29-38 years (43.6%) and this compares favourably with the 35.9% reported between 25-34 years by Lombardi *et al* 2009. This was followed by the welders 19-28 years of age (21.8%).These two age groups (29-38 and 19-28 years) also had the highest population of welders with ocular injury (35.4% and 18.2% respectively). This is very similar to the 24.4% finding of a study 21 in Edo State, Nigeria which reported that the age group most affected by ocular injury is 21- 30 years. This could be attributed to the fact that these are the active years of life and most individuals are found to be engaged in one vocation or the other at this stage. Only few of the welders were aged 59 years and above (4.5%) and this could probably be as a result of old age so that most of them retired before this age.

Superficial foreign object (43.6%) was the most common ocular injury. This agrees with previous studies which also reported superficial foreign body to be the commonest injury among welders. Welding involves the use of metals which are usually beaten

into a desired shape before use. Metal chips can in the process may find their way into the eye and cause ocular injuries. Rokicki *et al.* (2011) also emphasized that injuries complicated by ocular foreign body should be particularly suspected in high- velocity metal events and welding is one of them. Photokeratitis (41.0%) was the second leading ocular injury among these welders. This particular ocular injury could largely be due to the high thermal effect of ultraviolet radiation emissions from welding. The causative agents of ocular injury in this study were flying I objects (47.3%) such as metal chips and work tools, ultraviolet ray (45.2%) and gas splashes from welding gas (7.5%). Similar studies have reported the same sources of injury. However, this finding differs from that reported by Edema where sand dust was found to be the commonest cause. A larger number (76.9%) of ocular injuries occurred among the electric welders while only 23.1% occurred among the gas welders (table 2). This is contradictory to the report of another study 21 which reported that gas welders were more likely to have a history of work- related injury compared to electric welders and could be attributed to the fact that more welders in this area engaged in electric welding than gas welding.

It was observed that there is a higher risk of superficial foreign body embedment and photokeratitis as the number of years in service as a welder increased (table 3). This could be attributed to the increased exposure to flying objects and the accumulation of ultraviolet radiation emission over time.

Findings also showed that majority of the welders 67(60.9%) do not use protective eye wears because of reasons ranging from ignorance, inconvenience, discomfort, interference with visibility, lack of money to buy protective eye wears to lack of felt need, while only 39.1% of them used protective eye wear. The number of welders who used protective eye device in this study was low. It is however comparable to the 37.6% reported by Okeigbemen but is much lower than the 65% reported by Alakija. Also 60 out of the 93 welders with ocular injury had no protective eye wear at the time of the injury (table 4) of those who had ocular injury used protective eye wear and the occurrence of eye injury |among them could be as a result of recall bias or donning of protective eye device. Studies have shown that eye injuries are frequent when protective eye devices are not used and are highly preventable by using the correct safety wear. This therefore Highlights the need to institute and enforce policies on the regular use of protective eye devices in the work place.

Conclusion

There is a high prevalence of work-related ocular injury among welders in Owerri, Imo State, Nigeria. It is important to recognize conditions in the work pattern of welders which predispose them to injuries; such as lack of use of protective eye devices. Safety policies should be instituted and occupational safety intervention programs designed and carried out by eye care providers to prevent the occurrence of ocular injuries among welders in the area. Periodic evaluation should also be carried out to assess the efficacy of and compliance with safety devices by welders. Injury surveillance system should be established by the relevant authorities for monitoring and reporting of occupational ocular injuries.

It concluded that exposure to the radiations emitted during welding at the welder's work environment without appropriate protection gear mainly produce the ocular conditions, including pterygium, photokeratitis and cataract with their major symptoms, such as burning sensations, photophobia and eye pain.

Recommendation

Consistent use of eye protection as well as face protection, among welders should be encouraged. Enlightenment programs or awareness campaign should be embarked on as these means highlight the vulnerability of the eyes (cornea), the hazards of the job and the consequences of poor vision. Governments also have important roles to play in this direction. Routine eye check-up should be made available in most of this industrial set-ups (welding) as part of the employee's benefit scheme. Employers of labour in this area should provide their workers with protective eye wears since non affordability could be a pathway to non-use. This will go a long way in the reduction of attendant hazards, and improve the efficiency of the welders and other industrial workers.

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